

Tectonics and Fireballs

To solve problems, scientists ask scientific questions. They determine the best methods to answer the question, collect the data, and analyze it to draw evidence-based conclusions that answer the question. You will be practicing these steps in the **process of science** in this lab.

Learning objectives:

- Students will be able to compare the patterns and causes of earthquakes, volcanoes, and fireballs to tectonic plate boundaries.
- Students will be able to apply and analyze steps in the **process of science** (scientific literacy).
- Students will be able to identify and analyze **assumptions** (quantitative literacy).
- Students will be able to calculate **percentage** (quantitative literacy).

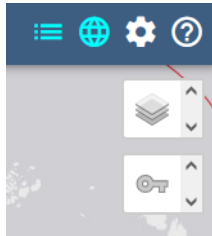
Materials needed:

- Access to [USGS Latest Earthquake application](https://earthquake.usgs.gov/earthquakes/map) (<https://earthquake.usgs.gov/earthquakes/map>)
- Access to [Interactive Map of Active Volcanoes and Recent Earthquakes](https://www.volcanoesandearthquakes.com/) (<https://www.volcanoesandearthquakes.com/>)
- Access to NASA's [Fireballs Reported by U.S. Sensors](https://cneos.jpl.nasa.gov/fireballs) (<https://cneos.jpl.nasa.gov/fireballs>)

Part 1: Navigating the USGS Earthquake Application

Go to [USGS Latest Earthquake application](https://earthquake.usgs.gov/earthquakes/map) (<https://earthquake.usgs.gov/earthquakes/map>).

In the top right corner of the page, you will see these controls:



Here are some tips for navigating this website:

-  • The **List button** turns on/off a list of earthquakes; the total number of earthquakes is at the top, and you can check a box to show only the earthquakes on the map.
-  • The **Map button** turns on/off a map of the locations of earthquakes.
-  • The **Settings button** allows you to choose the time range and size of earthquakes shown.
-  • The **About button** provides additional information.
-  • The **Basemap and Overlay** allows you to change the basemap and turn map features on and off.
-  • The **Map Legend (key)** explains what the circle size and color mean.

Play around with these settings to become familiar with how to change them and what they show.

1. Click the key icon to see the key. What do the light yellow circles mean?

- ☐ Earthquakes that happened in the past hour
- ☐ Earthquakes that happened in the past day
- ☐ Earthquakes that happened in the past week
- ☐ Earthquakes that happened in the past month
- ☐ Earthquakes that are larger than a magnitude 2.5
- ☐ Earthquakes that are larger than a magnitude 4.5

2. Use the Basemap and Overlay button to figure out what the red lines represent.

- ☐ Borders of countries
- ☐ Major roads
- ☐ Edges of continents
- ☐ Plate boundaries
- ☐ Volcano hazards

Use the Settings button to figure out how many earthquakes of a magnitude 4.5 or larger have happened in the world in the past 30 days. Depending on your settings, you may need to first choose to view earthquakes magnitude 4.5+ in the U.S., then zoom out to see the world. The number of earthquakes shown on the map can be found above the list on the left.

3. Estimate the number of earthquakes around the world that are larger than magnitude 4.5.

- ☐ 0
- ☐ Approximately 14-16
- ☐ Approximately 40-60
- ☐ Approximately 400-600
- ☐ Approximately 14,000-16,000
- ☐ Approximately 40,000-60,000

Part 2: Collecting data about the locations of earthquakes

Is there a pattern to the locations of earthquakes in South America?

Consider the scientific question above about the pattern of the locations of earthquakes in South America. Using the [USGS Latest Earthquake application](#), you will collect data to answer this question. The methods to follow have been figured out for you, but you will collect the data and analyze it to use as evidence to critically think about the conclusion proposed below.

In Data Table 1 below, the locations are listed in the first column and different durations for data collection are listed across the top. Collect your data by filling in the number of earthquakes that have happened in the last day and last 30 days in different parts of South America. Please note: A strategy to help you count the earthquakes is to resize and move the map, so it shows the area that you're interested in. Then check the box at the top of the list of earthquakes to show only the earthquakes on the map. Use the data you collect in Data Table 1 to answer the questions below.

Data Table 1

Location	1 day, Magnitude 2.5+	30 days, Magnitude 4.5+
West coast (within approximately 1,000 kilometers/600 miles)		
East coast (within approximately 1,000 kilometers/600 miles)		
Central (the rest of the continent)		
Total		

Scientists calculate **percentages** to make data easier to compare and communicate. Percentages show how big something is relative to the total number. To calculate a percentage, take the number that you identified (the part you want to know about) and divide it by the total number identified, and multiply that by 100.

4. How would you calculate the **percentage** of earthquakes that happened on the West coast in the last 1 day?

- ☐ I would take the total number of earthquakes in the bottom row for 30 days, subtract that by the number of earthquakes on the West coast for 30 days, and multiply that by 100.
- ☐ I would take the number of earthquakes on the West coast for 1 day, divide that by the total number of earthquakes for 1 day, and multiply that by 100.
- ☐ I would take the number of earthquakes on the West coast for 30 days, divide that by the number of earthquakes on the West coast for 1 day, and multiply that by 100.
- ☐ I would take the number of earthquakes on the West coast for 1 day, divide that by the number of earthquakes on the West coast for 30 days, and multiply that by 100.

5. Calculate the **percentage** of earthquakes that happened on the West coast in the last 30 days.
_____ %

A fellow student proposes the following conclusion: **“All earthquakes occur on the West coast. My evidence is that one earthquake happened in the past day, and it happened on the West coast.”**

6. Based on the data you collected in Data Table 1, do you agree or disagree with this conclusion?

- ☐ I agree with the conclusion, and I think the student supports it with good evidence.
- ☐ I agree with the conclusion, but I think the student could support it with better evidence.
- ☐ I disagree with the conclusion, but I think the student supports it with good evidence.
- ☐ I disagree with the conclusion, and I think the student could use better evidence.

7. Based on the data you collected, how would you fix the student's conclusion statement, so it includes numerical data?

- ☐ I wouldn't change it: All earthquakes occur on the West coast.
- ☐ I would change it slightly: 100% of earthquakes occur on the West coast.
- ☐ I would change it slightly: Most earthquakes occur on the West coast.
- ☐ I would change it slightly: Over 70% of earthquakes occur on the West coast.
- ☐ I would change it considerably: Earthquakes are randomly distributed around South America.
- ☐ I would change it considerably: Earthquakes are equally divided with 50% on each coast.

8. How would you change the evidence used in the student's conclusion statement based on the data you collected?

- ☐ I wouldn't change it: Evidence from the past day is good and fully represents the earthquakes that happen.
- ☐ I would change it: Evidence from the past 30 days is better, because the more data you have, the more confident you are.
- ☐ I would change it: Evidence from the past 10 years is better, because there is no way to answer the question without thousands of earthquakes.

9. What part of the **process of science did you do, in the preceding question when you thought about how you would need to change the evidence?**

- ☐ Ask a scientific question
- ☐ Analyze data and develop conclusions
- ☐ Determine the methods to use
- ☐ Share results and conclusions
- ☐ Make observations and collect data

Scientists make **assumptions** when they are determining the methods to use to answer a scientific question. An assumption is something that is accepted to be true before data are collected or analyzed, so it is not a conclusion made from the data.

10. What is NOT an **assumption you made when determining how you would change the evidence?**

- ☐ More data points result in better evidence.
- ☐ The map accurately shows the dates and locations of earthquakes.
- ☐ There was a normal number of earthquakes that happened in the Earth in the past 1 day and 30 days.
- ☐ More earthquakes happen on the West coast, and fewer happen on the East coast.

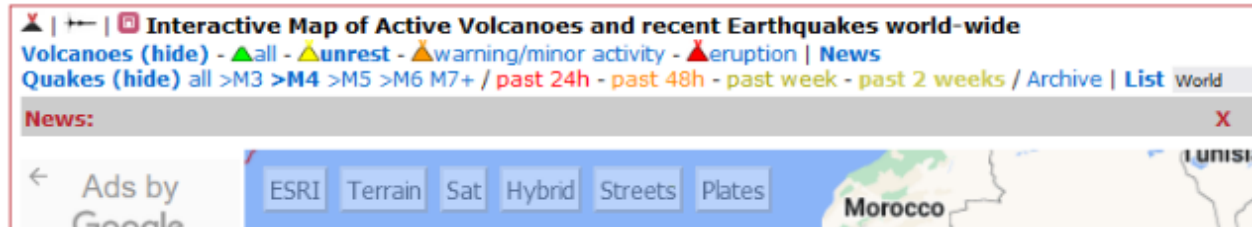
11. Based on your observations, use scientific reasoning to identify a likely explanation for the distribution of earthquakes in South America.

- ☐ Earthquakes tend to happen along any coast because that is where ocean waves hit the land.
- ☐ Earthquakes are distributed throughout the continent because they can happen anywhere on land.
- ☐ Earthquakes tend to happen on the West coast because there is a plate boundary there.
- ☐ Earthquakes tend to happen in the center because there are more faults distributed there.

Part 3: Navigating the Interactive Map of Active Volcanoes and Earthquakes

Go to the [Interactive Map of Active Volcanoes and recent Earthquakes](https://www.volcanoesandearthquakes.com/)
(<https://www.volcanoesandearthquakes.com/>).

In the top left of the page, you will see these controls:



Here are some tips for navigating this website:

- The words **Hide or Show** hides or shows the volcanoes or earthquakes on the map.
- You can click on the other **text** to show or hide volcanoes with different activity levels, earthquakes of different sizes (the M number or magnitude) and time frames, and a list of the earthquakes shown.
- Click on the **Streets button** to add labels of countries. Some of the questions will ask you about countries.
- Click on the **Plates button** to turn on and off plate boundaries. Some of the questions will ask you about plate boundaries.
- You may need to click on the arrow on the bottom left to **hide the ad** at the bottom of the page to show the +/- **zoom** buttons.

Play around with these settings to become familiar with how to change them and what they show. To begin, choose these settings:

- Hide the earthquakes and show just the volcanoes that are erupting (red).
- Click on the blue word "List" or the big, gray X to remove the list of earthquakes.
- Click on "Plates."
- Refresh the page to click on the text.

Change the setting to show all volcanoes. You may need to refresh the page.

12. Where are volcanoes located in South America?

- ☐ Along the West coast
- ☐ Along the south-east coast
- ☐ Along the north-east coast
- ☐ Scattered throughout randomly

13. What do the red and blue lines represent?

- ☐ Borders of countries
- ☐ Edges of continents
- ☐ Volcano hazards
- ☐ Major roads
- ☐ Plate boundaries

Part 4: Collecting data about earthquake and volcano locations



Volcanic eruption in Hawaii (source: USGS)

? Do earthquakes and volcanoes tend to happen in the same locations?

Consider the scientific question above about the location of earthquakes and volcanoes. To answer this question, a student drew Data Table 2 below, where the locations are listed in the first column, and the related features are in the next three columns. Using the [Interactive Map of Active Volcanoes and Recent Earthquakes](#), collect the data and analyze it to use as evidence to critically think about the conclusion proposed below.

In Data Table 2, fill in “yes” or “no” for each location (three have been done for you). The following settings and tips will help you:

- For volcanoes, click the yellow “unrest” volcano to include unrest, warning, and erupting volcanoes.
- For earthquakes, click >M4 to include M4 or greater earthquakes that have happened in the past 2 weeks.
- Turn on the plate boundaries by clicking “Plates” at the top of the map.
- If you refresh the page to click on the text to show different size or time frame earthquakes, you may need to rechoose the “unrest” and >M4 settings.

Data Table 2

Location	Volcano?	Earthquake?	Plate Boundary?
West coast of South America (e.g. Chile, Peru)			
East coast of South America (e.g. Brazil)			
West coast of Central America (e.g. Guatemala, Nicaragua)			
Center of North America			
Alaska islands (Aleutians)	Yes	Yes	Yes
Northern Europe (e.g. Norway, Sweden)	No	No	No
South coast of Australia			
Indonesia			
Japan	Yes	Yes	Yes

14. What part of the **process of science** did you do, when you filled in Data Table 2 above?

- ☐ Ask a scientific question
- ☐ Determine the methods to use
- ☐ Make observations and collect data
- ☐ Analyze data and develop conclusions
- ☐ Share results and conclusions

As previously noted, scientists must make **assumptions**. One of the assumptions made when determining the methods to answer this scientific question was that the data are collected during a period of time that is normal.

15. If this **assumption** is wrong, how would it affect your conclusions?

- ☐ I would overestimate volcanoes and underestimate earthquakes.
- ☐ I would underestimate volcanoes and overestimate volcanoes.
- ☐ I would have lower confidence in the conclusion.
- ☐ I would have higher confidence in the conclusion.

16. There are several ways you can change the methods to increase the trust you have in your conclusions. What is NOT one of them?

- ☐ I could use a longer period of time.
- ☐ I could zoom in closer to each location.
- ☐ I could look at more locations.
- ☐ I could verify the locations of earthquakes using another website.

17. Besides Northern Europe, what **three** other locations from Data Table 2 did you observe that do NOT have volcanoes, earthquakes, or a plate boundary?

- ☐ West coast of South America (e.g. Chile, Peru)
- ☐ East coast of South America (e.g. Brazil)
- ☐ West coast of Central America (e.g. Guatemala, Nicaragua)
- ☐ Center of North America
- ☐ South coast of Australia
- ☐ Indonesia

18. What are examples of locations that you observed with volcanoes, earthquakes, and a plate boundary?

- ☐ West coast of Central America and Indonesia
- ☐ West coast of South America and East coast of South America
- ☐ Center of North America and Alaska islands
- ☐ Japan and South coast of Australia

A fellow student proposes the following conclusion: **“Earthquakes and volcanoes both tend to happen in a pattern, and the majority of their locations are near plate boundaries.”**

19. Based on the evidence you collected in Data Table 2, do you agree or disagree with this conclusion?

- ☐ I agree because the statement is supported by the data I collected
- ☐ I disagree because the statement is not supported by the data I collected

20. Which part of the conclusion IS supported by the data you collected?

- ☐ Earthquakes tend to happen in a pattern
- ☐ Volcanoes tend to happen in a pattern
- ☐ Earthquakes and volcanoes both tend to happen in a pattern
- ☐ The majority of earthquakes are near plate boundaries
- ☐ The majority of volcanoes are near plate boundaries
- ☐ The majority of earthquakes and volcanoes are near plate boundaries
- ☐ None of the statement is supported by my data
- ☐ All of the statement is supported by my data

Part 5: Navigating Fireballs Reported by NASA Sensors



A fireball from a meteor burning in Earth's atmosphere (source: NASA).

A fireball is a bright meteor that forms when an object from space burns up in Earth's atmosphere. Go to [NASA's Fireballs Reported by U.S. Sensors](https://cneos.jpl.nasa.gov/fireballs) (<https://cneos.jpl.nasa.gov/fireballs>) webpage.

- You can adjust the map to limit data to events with an impact energy larger than a certain size by using the pull-down menu beneath it.
- You can see all entries by choosing "show all" entries.

You will be asked to calculate the percentage of fireballs with an impact energy of larger than 10 kilotons of TNT (kt) that have been reported since 1988. Note the two numbers below that you need to calculate the percentage:

Your note: The part you want to know about _____ Total number _____

21. Calculate the **percentage** of fireballs with an impact energy of larger than 10 kilotons of TNT (kt) that have been reported since 1988.

- | | |
|---|---|
| ☐ Approximately 1% | ☐ Approximately 90% |
| ☐ Approximately 10% | ☐ Approximately 99% |
| ☐ Approximately 50% | |

22. What impact energy is LEAST common?

- | | | | |
|------------------------------|---------------------------|-----------------------------|------------------------------|
| ☐ 0.1 kt | ☐ 1kt | ☐ 10 kt | ☐ 100 kt |
| ☐ 0.3 kt | ☐ 3kt | ☐ 30 kt | |

Part 6: Analyzing data about the location of fireballs

? Is there a pattern to the locations of fireballs in South America?

A student examines the scientific question above about the locations of fireballs in South America. The student decides the best method to answer this question is to use [NASA's Bolide Detections from Geostationary Lightning Mapper](#) website and collects the following data in Data Table 3. What conclusions can you make from the data?

Data Table 3

Location	1 day	7 days	30 days
West coast (within 500 kilometers/300 miles)	0	0	8
East coast (within 500 kilometers/300 miles)	0	3	11
Central (the rest of the continent)	1	2	9
Total	1	5	28

Use the data in Data Table 3 above to calculate the **percentage** of fireballs that happened for the 30 days column in the Data Table 4 below. The calculations for the other columns have been done for you.

Data Table 4

Location	1 day	7 days	30 days
West coast (within 500 kilometers/300 miles)	0%	0%	
East coast (within 500 kilometers/300 miles)	0%	60%	
Central (the rest of the continent)	100%	40%	
Total	100%	100%	100%

23. How did you calculate the **percentage** of fireballs?

- ☐ I took the total number of fireballs, subtracted that by the number of fireballs on the West coast, and multiplied that by 100.
- ☐ I took the number of fireballs on the West coast, divided that by the total number of fireballs, and multiplied that by 100.
- ☐ I took the total number of fireballs, divided that by the number of fireballs on the West coast, and multiplied that by 100.
- ☐ I took the percent of fireballs on the West coast for 1 day, added that by the percent of fireballs on the West coast for 7 days, and multiplied that by 100.

24. What **percentage** of fireballs happened on the West coast in 30 days. _____%

25. What is a scientific question that could be answered by calculating the **percentage** using the total across the rows instead of the total down the columns in Data Table 3?

- ☐ What percentage of fireballs in the last day happened along the West coast?
- ☐ What percentage of fireballs in the last month happened in the last day?
- ☐ What percentage of fireballs happened in the Central U.S. in the last week?
- ☐ What percentage of fireballs happened along either coast of the U.S. in the last month?

26. Study the data about fireballs in Data Tables 3 and 4. Which of these is an **assumption** that you must make in order to compare the fireballs between the three locations?

- ☐ I assumed that 1 day of data tells the same information as 30 days of data.
- ☐ I assumed that the area covered by each location is about the same.
- ☐ I assumed that the West coast has more fireballs.
- ☐ I assumed that fireballs can do a lot of damage if they are big enough.

27. Select the evidence-based conclusion that answers the scientific question regarding the pattern of fireballs.

- ☐ Fireballs have a pattern and are more likely to occur along the coasts.
- ☐ Fireballs have a pattern and are less likely to occur on the West coast.
- ☐ Fireballs have a pattern and mostly occur on the West coast.
- ☐ Fireballs do not have a pattern in location.

28. What numerical evidence did you use to draw your conclusion for answering the question regarding the pattern of fireballs?

- ☐ The best numerical evidence comes if you add the West coast and East coast numbers together for all timeframes, they add to 61%, which is more than the central numbers.
- ☐ The best numerical evidence is that for both 1 day and 7 days, 0% of fireballs happened on the West coast.
- ☐ The best numerical evidence is to look at 30 days because it has the most data, and it shows the distribution to be between 25% and 40% across locations.
- ☐ The best numerical evidence is that they are all about the same.
- ☐ The best numerical evidence is that the highest number for the different timeframes is not always in the same location. For 1 day it's central and for 7 and 30 days it's East coast.

Part 7: Determining why the observed patterns exist

In this lab so far, you have identified patterns in the distribution of earthquakes, volcanoes, and fireballs (bright meteors).

Why are there patterns in the location data for earthquakes and volcanoes?

You are asked the scientific question above about the cause of the patterns you identified. The questions below guide you through the scientific reasoning needed to determine the likely cause of the patterns and answer the question.

29. Which statement best summarizes the patterns you observed?

(_____ tend to happen in the same pattern forming lines, and _____ are randomly distributed)

- ☐ Volcanoes and fireballs tend to happen in the same pattern forming lines, and earthquakes are randomly distributed.
- ☐ Earthquakes and volcanoes tend to happen in the same pattern forming lines, and fireballs are randomly distributed.
- ☐ Fireballs and earthquakes tend to happen in the same pattern forming lines, and volcanoes are randomly distributed.
- ☐ Earthquakes, volcanoes, and fireballs all tend to happen in the same pattern forming lines, and none are randomly distributed.
- ☐ None tend to happen in the same pattern forming lines, and earthquakes, volcanoes, and fireballs are all randomly distributed.

Do some brief independent research to learn how the processes that cause earthquakes, volcanoes, and fireballs differ. In the previous question, you stated your observations. In the next questions, you will make interpretations of those observations.

30. Based on your research, where would you expect most earthquakes to happen?

- ☐ Where the daytime temperature is hottest
- ☐ Along plate boundaries
- ☐ Near the equator
- ☐ At the point beneath the full moon
- ☐ No specific place—they are randomly distributed

31. Based on your research, where would you expect most volcanoes to happen?

- ☐ Where the daytime temperature is hottest
- ☐ Along plate boundaries
- ☐ Near the equator
- ☐ At the point beneath the full moon
- ☐ No specific place—they are all randomly distributed

32. Based on your research, where would you expect most fireballs to happen?

- ☐ Where the daytime temperature is hottest
- ☐ Along plate boundaries
- ☐ Near the equator
- ☐ At the point beneath the full moon
- ☐ No specific place—they are randomly distributed

33. How and why do the locations of earthquakes, volcanoes, and fireballs relate to each other?

- ☐ Earthquakes and volcanoes have a similar pattern (their patterns correlate) because they have the same cause, while fireballs have a different pattern and cause.
- ☐ Volcanoes and fireballs have a similar pattern (their patterns correlate) because they have the same cause, while earthquakes have a different pattern and cause.
- ☐ Fireballs and earthquakes have a similar pattern (their patterns correlate) because they have the same cause, while volcanoes have a different pattern and cause.
- ☐ Earthquakes, volcanoes, and fireballs all have a similar pattern (their patterns correlate) because they have the same cause.
- ☐ Earthquakes, volcanoes, and fireballs all have different patterns and causes.

Part 8: Synthesizing the process of science

? Do the Aleutian Islands in Alaska and the Florida Keys in Florida experience similar non-weather geologic hazards and why?

You are asked the scientific question above about the hazards in the chains of islands found in Alaska and in Florida. You collect the following information:

- Number of earthquakes in the Aleutian Islands and Florida Keys over the past 30 days.
- Location of volcanoes in unrest and active in the Aleutian Islands and Florida Keys.
- Number of fireballs in the Aleutian Islands and Florida Keys over the past 30 days.

34. What is one additional piece of data that would be useful to collect?

- ☐ Phase of the moon
- ☐ The season
- ☐ Average temperature
- ☐ Location of plate boundaries
- ☐ How close they are to the equator

35. What part of the **process of science** did you do in the preceding question, when you were identifying additional data to collect?

- ☐ Ask a scientific question
- ☐ Analyze data and develop conclusions
- ☐ Determine the methods to use
- ☐ Share results and conclusions
- ☐ Make observations and collect data

Scientists share their results to help scientific progress, inform public policy, and improve the lives of citizens. Sharing usually takes the form of a research report (also called a scientific paper). Research reports include the research question, the methods used to answer the question, the data collected, and evidence-based conclusions.

36. Why are research reports important in science?

- ☐ They share conclusions, so other scientists and decision-makers can build on and use that knowledge.
- ☐ They share methods, so other scientists can make sure the methods are reliable and measure what the authors claim they do.
- ☐ They share data, so other scientists can confirm the conclusions are based on evidence.
- ☐ All of these are true.

? Do the coasts around the Pacific Ocean and the Atlantic Ocean experience similar non-weather geologic hazards and why?

You are asked to write a research report answering the above scientific question about hazards on the coasts around the Pacific Ocean and the Atlantic Ocean. You will want to review the websites you've used in this lab to help you make observations to answer this question.

- [USGS Latest Earthquake application](https://earthquake.usgs.gov/earthquakes/map) (<https://earthquake.usgs.gov/earthquakes/map>)
- [Interactive Map of Active Volcanoes and Recent Earthquakes](https://www.volcanoesandearthquakes.com/) (<https://www.volcanoesandearthquakes.com/>)
- NASA's [Fireballs Reported by U.S. Sensors](https://cneos.jpl.nasa.gov/fireballs) (<https://cneos.jpl.nasa.gov/fireballs>)

Here is the **first sentence** of your report:

On the webpages given, I counted the number of earthquakes, volcanoes, and fireballs that occurred within 300 miles of the coast of the Pacific Ocean and the Atlantic Ocean in the last 30 days.

37. Which sentence is a good **second sentence for your report?**

- ☐ I also noted the phase of the moon.
- ☐ I also noted the average high and low temperatures.
- ☐ I also noted if there was a plate boundary.
- ☐ I also noted the number of islands.
- ☐ I didn't note anything else.

38. Which sentence is a good **third sentence for your report?**

- ☐ I recorded the data I collected into a table, with three rows labeled Pacific Ocean, Atlantic Ocean, and plate boundary and three columns labeled earthquakes, volcanoes, and fireballs.
- ☐ I recorded the data I collected into a table, with two rows labeled Pacific Ocean and Atlantic Ocean, and four columns labeled earthquakes, volcanoes, fireballs, and temperature.
- ☐ I recorded the data I collected into a table, with three rows labeled Pacific Ocean, Atlantic Ocean, and temperature and three columns labeled earthquakes, volcanoes, and fireballs.
- ☐ I recorded the data I collected into a table, with two rows labeled Pacific Ocean and Atlantic Ocean, and four columns labeled earthquakes, volcanoes, fireballs, and plate boundary.

Use the space below to create your table and enter data into the table. You may need to use approximate numbers to make sure this data collection does not take longer than 5 minutes. Then, use the numbers and percentages you calculate in your table to answer the next question.

39. Which sentence is the best **fourth sentence** for your report?

- ☐ I calculated percentages from my count and I identified that most earthquakes and volcanoes happen along the Pacific Ocean coast, which only a few fireballs do.
- ☐ I calculated percentages from my counts, and I identified that 68% of earthquakes, 75% of volcanoes, and 74% of fireballs happen along the Pacific Ocean coast.
- ☐ I calculated percentages from my counts, and I identified that 98% of earthquakes, 95% of volcanoes, and 55% of fireballs happen along the Pacific Ocean coast.
- ☐ I calculated percentages from my counts, and I identified that 52% of earthquakes, 93% of volcanoes, and 47% of fireballs happen along the Pacific Ocean coast.

40. Which sentence is a good **fifth sentence** for your report?

- ☐ The Pacific Ocean has more islands in it than the Atlantic Ocean.
- ☐ The Pacific Ocean coast has warmer average temperatures than the Atlantic Ocean coast.
- ☐ The Pacific Ocean has more full moons than the Atlantic Ocean.
- ☐ The Pacific Ocean coast has colder average temperatures than the Atlantic Ocean coast.
- ☐ The Pacific Ocean is surrounded by plate boundaries while the Atlantic Ocean is mostly not.
- ☐ The Pacific Ocean is not surrounded by plate boundaries while the Atlantic Ocean mostly is.

41-43. Fill in the blanks for the **final sentence** for your report:

Therefore, I conclude that the ____ [A] ____ coast has most of the ____ [B] ____ because
____ [C] _____, and ____ [D] ____ happen along both coasts
because ____ [E] _____.

41. What fits in the [A] and [B] blanks?

- ☐ A: Atlantic; B: earthquakes and volcanoes
- ☐ A: Atlantic; B: earthquakes, volcanoes, and fireballs
- ☐ A: Pacific; B: earthquakes and volcanoes
- ☐ A: Pacific; B: earthquakes, volcanoes, and fireballs

42. What fits in the [C] blank?

- ☐ it is on a plate boundary
- ☐ they are random from space
- ☐ there are more islands
- ☐ the temperatures are different
- ☐ the phase of the moon changes

43. What fits in the [D] and [E] blanks?

- ☐ D: fireballs; E: they are random from space
- ☐ D: earthquakes; E: it is on a plate boundary
- ☐ D: volcanoes; E: there are more islands
- ☐ D: earthquakes and volcanoes; E: the temperatures are different

44. What part of the **process of science** does the **final** sentence describe?

- ☐ Ask a scientific question
- ☐ Determine the methods to use
- ☐ Make observations and collect data
- ☐ Analyze data and develop conclusions
- ☐ Share results and conclusions

Reflection

45. Which question in this lab connects to your personal experience? Consider the lab topic, math skills, and the process of science. You may also consider your lived experience or stories you've encountered. To earn credit, list the question number and explain how it relates in 2-3 sentences.